UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/697,028	10/31/2003	Jin K. Kim	15436.441.10	1089

22913 7590 11/28/2005

WORKMAN NYDEGGER
(F/K/A WORKMAN NYDEGGER & SEELEY)
60 EAST SOUTH TEMPLE
1000 EAGLE GATE TOWER
SALT LAKE CITY, UT 84111

EXAMINER	
AL NAZER, LEITH A	
ART UNIT	**PAPER NUMBER**
2821	

DATE MAILED: 11/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

4-A

Office Action Summary	Application No.	Applicant(s)	
	10/697,028	KIM, JIN K.	
	Examiner	Art Unit	
	Leith A. Al-Nazer	2821	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *31 October 2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1-8, 10-12, 14, 16, and 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,493,372 to Boucart et al. in view of U.S. Patent Application Publication No. 2003/0103543 to Moser et al.

With respect to claim 1, Boucart teaches a vertical cavity surface emitting laser, comprising: a substrate (24); a first mirror stack (14) over the substrate; an active region (16 or 18) having a plurality of quantum wells (figure 10) over the first mirror stack; a tunnel junction (20 or 22) over the active region; and a second mirror stack (12) over the tunnel junction. Claim 1 requires a p-layer of the tunnel junction include GaPSb or

AlGaPSb. GaPSb and AlGaPSb, as well as their respective properties, are both well-known in the art, as is evidenced by Moser (table 1). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the p-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

Claim 2 requires that the tunnel junction further include a compound selected from the group consisting of InP, AlInAs, AlInGaAs, InGaAs, and InGaAsP. Such materials, as well as their respective properties, are well-known in the art, as is evidenced by Boucart (column 9, lines 33-43). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the n-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

With respect to claim 3, Boucart teaches an n-type spacer (column 9, lines 49-54) adjacent the active region, and wherein the first mirror stack is an n-type DBR (column 5, line 60 – column 6, line 15).

With respect to claim 4, Boucart teaches a p-type spacer (column 9, lines 55-60) adjacent the tunnel junction, and wherein the second mirror stack is an n-type DBR (column 5, line 60 – column 6, line 15).

With respect to claim 5, Boucart teaches an n-type bottom spacer (column 9, lines 49-54) adjacent the active region, and wherein the first mirror stack being an n-

type DBR (column 5, line 60 – column 6, line 15); and a p-type top spacer (column 9, lines 55-60) adjacent the tunnel junction; wherein the first and second mirror stacks are each an n-type DBR (column 5, line 60 – column 6, line 15).

Claims 6-8 require the p-layer be grown by MOCVD or MBE. Such processes are well known in the art, as is evidenced by Boucart (column 9, lines 43-49). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to grow the p-layer of the tunnel junction with MOCVD or MBE. The motivation for doing so would have been to grow the p-layer in a reliable, time efficient, and cost efficient manner.

With respect to claim 10, Boucart teaches the active region including one of InGaAs, InGaAsP, and AlInGaAs (column 5, lines 60-64).

With respect to claim 11, Boucart teaches the first and second mirror stacks being lower and upper mirror stacks, respectively (12 and 14 in figure 1A).

With respect to claim 12, Boucart teaches a tunnel junction. Claim 12 requires the tunnel junction have a p-layer including GaPSb or AlGaPSb. GaPSb and AlGaPSb, as well as their respective properties, are both well-known in the art, as is evidenced by Moser (table 1). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the p-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

With respect to claim 14, Boucart teaches an n-doped layer a compound in the group consisting of InP, AlInAs, InGaAs, AlInGaAs, and InGaAsP. Such materials, as

well as their respective properties, are well-known in the art, as is evidenced by Boucart (column 9, lines 33-43). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the n-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

With respect to claim 16, Boucart teaches the n-doped layer being less than about 100 nanometers thick (column 5, line 60 – column 6, line 15).

With respect to claim 18, Boucart teaches a long wavelength VCSEL, comprising: an indium-based semiconductor substrate (24; column 5, line 60 – column 6, line 15); a first mirror stack (14) over the substrate; an active region (16 or 18) having a plurality of quantum wells (figure 10) over the first mirror stack; a tunnel junction (20 or 22) over the active region; and a second mirror stack (12) over the tunnel junction. Claim 18 requires a p-layer of the tunnel junction include GaPSb or AlGaPSb. GaPSb and AlGaPSb, as well as their respective properties, are both well-known in the art, as is evidenced by Moser (table 1). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the p-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

With respect to claim 19, Boucart teaches an n-layer of the tunnel junction further including a compound selected from the group consisting of InP, AlInAs, InGaAs,

AlInGaAs, and InGaAsP. Such materials, as well as their respective properties, are well-known in the art, as is evidenced by Boucart (column 9, lines 33-43). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize such materials in the n-layer of the tunnel junction of Boucart. The motivation for doing so would have been to provide a layer with advantageous properties, such as a specific electrical or thermal conductivity.

With respect to claim 20, Boucart teaches an n-type spacer (column 9, lines 49-54) adjacent the active region, and wherein the first mirror stack is an n-type DBR (column 5, line 60 – column 6, line 15).

With respect to claim 21, Boucart teaches a p-type spacer (column 9, lines 55-60) adjacent the tunnel junction, and wherein the second mirror stack is an n-type DBR (column 5, line 60 – column 6, line 15).

With respect to claim 22, Boucart teaches an n-type bottom spacer (column 9, lines 49-54) adjacent the active region, and wherein the first mirror stack is an n-type DBR (column 5, line 60 – column 6, line 15); and a p-type top spacer (column 9, lines 55-60) adjacent the tunnel junction, wherein the first and second mirror stacks are each an n-type DBR (column 5, line 60 – column 6, line 15).

4. Claims 9, 13, 15, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,493,372 to Boucart et al. in view of U.S. Patent Application Publication No. 2003/0103543 to Moser et al. as applied to claims 1-8, 10-

12, 14, 16, and 18-22 above, and further in view of U.S. Patent No. 6,931,042 to Choquette et al.

Claims 9 and 13 require the p-layer be doped with carbon with a concentration greater than about $2x10^{18}$ cm^{-3}. Doping the p-layer of a tunnel junction with carbon with a concentration greater than $2x10^{18}$ cm^{-3} is well known in the art, as is evidenced by Choquette (column 8, line 62 – column 9, line 9). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize carbon dopant in the p-layer of the tunnel junction taught by Boucart. The motivation for doing so would have been to provide a tunnel junction with advantageous properties, such as a specific electrical conductivity.

Claim 15 requires the n-doped layer be doped with a concentration greater than about $2x10^{18}$ cm^{-3}. Doping the n-doped layer with a concentration greater than $2x10^{18}$ cm^{-3} is well known in the art, as is evidenced by Choquette (column 8, line 62 – column 9, line 9). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to dope the n-layer of the tunnel junction taught by Boucart with a concentration greater than $2x10^{18}$ cm^{-3}. The motivation for doing so would have been to provide a tunnel junction with advantageous properties, such as a specific electrical conductivity.

With respect to claim 17, Boucart teaches the n-doped layer being less than about 100 nanometer thick (column 5, line 60 – column 6, line 15). Claim 17 requires the n-doped layer be doped with a concentration greater than about $2x10^{18}$ cm^{-3}. Doping the n-doped layer with a concentration greater than $2x10^{18}$ cm^{-3} is well known in

the art, as is evidenced by Choquette (column 8, line 62 – column 9, line 9). Therefore, at the time of the invention, it would have been obvious to one having ordinary skill in the art to dope the n-layer of the tunnel junction taught by Boucart with a concentration greater than $2x10^{18}$ cm^{-3}. The motivation for doing so would have been to provide a tunnel junction with advantageous properties, such as a specific electrical conductivity.

Citation of Pertinent References

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following references further show the state of the art with respect to VCSEL structures including a tunnel junction:

a. Non-patent literature to Hall et al. (see PTO-892)

b. Non-patent literature to Zhou et al. (see PTO-892)

c. U.S. Patent Application Publication No. 2005/0002430 to Ryou

d. U.S. Patent Application Publication No. 2004/0218655 to Tandon et al.

e. U.S. Patent Application Publication No. 2004/0217343 to Chang et al.

f. U.S. Patent Application Publication No. 2003/0156610 to Kwon

g. U.S. Patent No. 6,813,293 to Johnson et al.

h. U.S. Patent No. 6,810,065 to Naone

i. U.S. Patent No. 6,771,680 to Bour et al.

j. U.S. Patent No. 6,765,238 to Chang et al.

Communication Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leith A. Al-Nazer whose telephone number is 571-272-1938. The examiner can normally be reached on Monday-Friday, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Don Wong can be reached on 571-272-1834. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LA

Shih-Chao Chen 11/23/05
SHIH-CHAO CHEN
PRIMARY EXAMINER